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Restoring Wild Salmon to the Pacific Northwest: Framing the Risk Question[1]

Robert T. Lackey[2]

National Health and Environmental Effects Research Laboratory
Office of Research and Development
U.S. Environmental Protection Agency
200 SW 35th Street
Corvallis, Oregon 97333 USA

lackey.robert@epa.gov
(541) 754-4607

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[2]Dr. Lackey is also courtesy professor of fisheries science and adjunct professor of political science at Oregon State University.

Abstract

In the Pacific Northwest of the United States, it is urgent to assess accurately the various options proposed to restore wild salmon. For the past 125 years, a variety of analytic approaches have been employed to assess the ecological consequences of salmon management options. Each approach provided useful information to decision makers, but each also suffered from limitations, some relatively minor, others sufficient to undermine any potential utility. Risk assessment has become the most widely used analytic approach to evaluate environmental policy options. To date its use in ecological policy has been largely constrained to evaluating relatively simple technical questions (e.g., regulatory actions associated with specific chemicals or hazardous waste sites). Recently, however, there has been interest in applying risk assessment to more complex ecological policy problems (e.g., the decline of wild salmon in the Pacific Northwest). Although its use has become commonplace and widely accepted, especially among regulatory and land management agencies, risk assessment remains contentious. The most heated debates revolve around delineating the specific meaning of risk; that is, framing the risk "question" to be answered.

Introduction

Accurately evaluating the ecological consequences of options to restore wild salmon in the Pacific Northwest of North America would help society make important restoration policy decisions (Lackey 1999). Although often debated politically over narrow, simplistic alternatives (*e.g.*, breaching a particular dam, closing fishing in a certain location, banning a type of fishing gear, approving a specific river dredging request), salmon restoration is a pervasive issue that could directly affect all residents of the region. Unfortunately, providing reliable ecological assessments of the restoration options continues to be a formidable challenge.

For the past 150 years, analysts, scientists, and others have used a variety of analytic approaches to assess the consequences of salmon policy options (Lackey 1997b; Lichatowich 1999). Salmon declines began in the 1850s and crude analytical efforts followed that attempted to assess the causes and the efficacy of various policy options. In subsequent years different analytical techniques were employed in salmon policy analysis. Each technique potentially provided useful information to decision makers, but each also suffered from limitations, some relatively minor, others sufficient to undermine any potential utility in decision making.

Over the past two decades, risk assessment has emerged as the most popular analytic tool used in ecological policy analysis (Molak 1996; Lackey 1997a; Power and Adams 1997; Power and McCarty 1997; O'Brien 2000). The approach is conceptually straight forward. Risk, by definition, requires delineation of an "adverse" event or condition. Risk "assessment" is the process of estimating the probability of the delineated adverse event or condition occurring (Perhac 1996). Risk "management" is a decision making process involving a suite of factors, one of which is an assessment of risk.

Generally, analysts working on ecological policy issues have used risk assessment to evaluate relatively simple technical questions like estimating the likelihood or probability of experiencing an undesired ecological consequence from use or disposal of a man-made chemical (Molak 1996; Lackey 1997a). However, within the past few years there have been attempts to use risk assessment to analyze complex ecological policy problems such as efforts to restore wild salmon (Fairbrother *et al*. 1995; Lackey 1997b; Power and Adams 1997; Walker *et al*. 2001).

My purpose here is to examine the potential of risk assessment to contribute helpful information to the policy issues associated with salmon restoration. My intent is not to lobby for or against use of risk assessment or any other analytical tool, nor to crusade for a particular salmon restoration option, nor even to claim that restoring salmon is an appropriate public policy goal. Rather, I wish to consider the appropriate role of risk assessment in helping resolve the ongoing salmon policy debates in the Pacific Northwest.

Formulating the Restoration Objective

Restoring salmon to the Pacific Northwest might seem to be an indisputable public policy objective. After all, during the past 150 years, many runs of wild salmon have declined and society, it would seem, desires to reverse the downward trend and restore wild salmon runs. [See Lackey (1999, 2000), Lichatowich (1999), and Taylor (1999) for detailed discussions of salmon science and policy]. An appropriate and realistic policy objective for salmon restoration is neither obvious nor intuitive. No societal consensus exists on what the restoration objective should be, exclusive of sweeping generalities (Lackey 2000).

There are two closely related, but distinctly different, aspects to formulating a credible restoration objective for wild salmon. One is determining a suite of ecologically *feasible* objectives. Although there will always be considerable

uncertainty about what is attainable ecologically, the harsh reality in salmon policy is that many potential restoration objectives are simply not ecologically plausible within the foreseeable future (a century or two) (Lichatowich 1999; Michael 1999; Lackey 2000). Some restoration strategies, although appearing to offer a possibility of success, are highly unlikely to be acceptable to most members of society. Viable options, however, do exist, but each has its own risk factors, probability of success, and cost to society.

Arguably more challenging than assessing the consequences of potential policy options is selecting the societally *preferred* option. This is the area where the instruments of governance (legislature, executive, and judicial entities) adjudicate the conflicting preferences of various elements of the public (Perhac 1996). It is here where society weights the social and economic costs of each of the competing options. Obviously, the selected option *should* be one that is ecologically feasible although such is not always the case in practice.

At the simplest level, salmon restoration is viewed by some as a matter of choosing among competing options, much as society makes choices over policies regarding energy, transportation, or international trade. Resolution is achieved by following the political process of reaching agreement by negotiation and compromise (Lackey 1999). In such a context, the objective for restoring salmon is the outcome of adjudicating competing priorities by the political process.

Others view salmon restoration (and the decline of salmon generally) in stark terms of right and wrong, moral and immoral. If a participant in the salmon policy debate views the decline of wild salmon as fundamentally a moral or ethical concern, political compromise is unlikely to be achieved easily. Where individuals or groups hold opposing moral or ethical positions, the effect is that the ultimate political resolution will be unconditionally win-lose (Lackey 1999).

Still others, probably a majority, may hold sympathetic views toward salmon restoration, but they view restoration options through the prism of beliefs, as well as personal preferences and perceived economic and other costs — the rights of the public *vs.* those of individuals; the rights of urban dwellers *vs.* those of rural residents; the rights of the present generation *vs.* those of future generations; cheap *vs.* expensive electricity; personal mobility *vs.* public transportation. In short, nearly *everyone* favors salmon restoration in the *abstract*, but individuals differ greatly over what they are willing to sacrifice to restore salmon runs.

It is not surprising that the policy debate over salmon restoration is often characterized by truculent adversaries who denigrate the motives of their opponents.

The fact is that the combatants do have different beliefs and agendas and that each policy option involves winners and losers. For example, society may conclude that restoring wild salmon is important, but regulations to achieve this societal objective should not *unfairly* burden only certain segments of society. What "unfair" is, of course, in the eyes of the beholder. The argument might be that no one should be required to relinquish his private property without compensation, coupled with the immediate response is that those individuals and segments of society that exacerbate the salmon decline or impede recovery ought to bear the cost of restoration. Unfortunately, it is nearly impossible to quantify the effect of individual actions with the decline of salmon so the "losers" are easily able to challenge on scientific grounds their culpability based on a weak cause-effect relationship. In reality it is collective actions of all which have caused the decline of wild salmon, and thus make it very difficult to restore them.

The Endangered Species Act is currently the most important legal driver of salmon policy in the Pacific Northwest, but, as with all laws, it is only a tool to help implement public policy. Therefore, it is important to determine the Act's implicit public policy goal with regard to restoration of wild salmon. Those who support invoking the Endangered Species Act to restore salmon numbers usually insist that the Act forces society to make necessary, though perhaps painful, trade-offs. The Act may not be perfect, they usually accede, but it is needed now more than ever as the decline of wild Pacific salmon demonstrates.

Arguments in support of the Endangered Species Act are sometimes framed as moral assertions and thus are not amenable to easy compromise. Accompanying the morally-based position, there may be references to the importance of protecting species because of their "commodity" value, their "option" value, or their use as "surrogates" for environmental quality, but the assertion is inherently whether humans have (or should have) a right to drive a species, or distinct population segment, to extinction. Conversely, preservation of species is often viewed as simply another competing societal preference, along with electricity, housing, food, mobility, economic advancement, and freedom from intrusive government.

Ecological and Societal Realities

Framing the policy objective for salmon restoration is not a purely biological issue, nor even a purely "salmon" issue, but rather one concern in a large universe of competing societal priorities intertwined with real and apparent realities (Menzie 1995). For example, overriding all discussions of salmon restoration is the reality that the human population of the North American Pacific Northwest is growing rapidly — at

rates comparable to those in some Third World countries — and shows little sign of leveling off, much less declining (Michael 1999). Nor is there much evidence that most members of society are willing to make the admittedly draconian changes in life styles necessary to restore wild salmon (Lackey 2000).

Some argue that it is an illusion to think that attempts to restore wild salmon in many watersheds will be successful (Michael 1999). The habitat of much of the Pacific Northwest is dramatically different than it was even a few hundred years ago. The Columbia River and most of its major tributaries, for example, are now dominated by a series of manmade lakes and pervasive hydrologic modifications. Land use in much of the watershed has changed the aquatic environment in ways that no longer favor salmon. As dramatic as the habitat changes are, some fishes are thriving, especially exotics such as walleye, American shad, smallmouth bass, northern pike, and brook trout. These exotic species are well adapted to the altered environment and generally enjoy widespread favor among recreational fishermen. Skeptics of widespread restoration argue that we are surely beyond the stage where we can re-create the habitat conditions necessary to support thriving runs of wild salmon in much of the region (Michael 1999).

There have been concerted efforts to systematically prioritize wild salmon stocks (roughly equivalent to "populations") to efficiently allocate society's efforts to protect and restore runs (Allendorf *et al*. 1997). One option often considered is to preserve stocks in particular locations, such as some coastal rivers, where some reasonably healthy wild stocks still exist and the chances of restoration are greater. Another, more radical option, is to stop focusing on *stocks* or clusters of stocks and accept that no *species* of salmon is in danger of extinction. But, is such acceptance of apparent reality merely admitting defeat in the face of difficult, expensive, and divisive policy choices?

The appropriate technical objective for salmon restoration is neither intuitive, nor obvious. Much of the debate has revolved around *which* of the multitude of restoration objectives should be adopted. All options must, however, be grounded in the near certain reality that the human population of the Pacific Northwest will be *several* times larger before the end of the 21st century, even though the *overall* population of North America may well level off at "only" twice its current level (Lackey 2000). The generally inverse relationship between the level of human activity and salmon abundance has been widely demonstrated.

Risk Assessment as a Analytic Tool

Salmon restoration is a complex policy issue by any criteria. Many analytical tools (*e.g.*, benefit/cost analysis, environmental assessment, computer simulation, fish population dynamics models, statistical analysis, game theory, alternative futures) have been used to assist decision makers and the public (Molak 1996). Risk assessment has become a commonly used tool for relatively simple, usually toxicological, policy problems since the 1980s. Its use in assisting decision making in many fields (*e.g.*, life, automobile, and health insurance, industrial processes, engineering failure analysis, institutional liability, and human health) has become commonplace and widely accepted, but its use in *ecological* policy remains contentious (Power and McCarty 1997; O'Brien 2000).

Opinions on the legitimacy of *ecological* risk assessment are diverse and extensively debated in the professional literature (Karr 1995; Power and Adams 1997). Support tends to be strong in government agencies and industries, but others challenge the entire notion of using any form of risk assessment in helping to resolve environmental or ecological policy issues:

> *"Risk assessment is a premier process by which illegitimate exercise of power is justified. The stakes of installing alternatives to risk assessment, therefore, are the whole Earth (just as are the stakes of fashioning democratic control over corporations, or of requiring changes in behavior of those who have wreaked irreparable damage)." (O'Brien 2000)*

In summary, opinions range from imploring (1) encouragement: "scientifically credible evaluation of the ecological effects of human activities" to (2) caution: "most quantitative ecological risk assessments are generally unvalidated and in many cases highly misleading" to (3) suspicion: "one more hurdle on the road to a permit" to (4) abhorrence: "risk assessment is a sham." Clearly, there are fierce and disparate attitudes about the proper role of risk assessment in addressing ecological policy issues (Power and Adams 1997).

The most heated policy-driven debate over using risk assessment in ecological policy analysis revolves around delineating the initial risk question to be answered and who participates in the "question framing" process (Menzie 1995; Perhac 1996; O'Brien 2000). To be technically tractable, rigorous, and credible, the risk question is usually delimited in fairly narrow, technical terms, often diminishing the policy relevance and breadth of the assessment, or even appearing to be misleading. Most often the narrowing is, or at least claimed to be, done by a policy mandate or management directive. The risk question then becomes relatively modest analytically [*e.g.*, what is the likelihood that a particular salmon stock will be lost if a

specific river dredging operation is permitted?]. The risk analysis may be technically complex, require exhaustive scientific information, and employ sophisticated statistical analyses, but it remains based on arbitrary, but highly contentious assertions about what is the *appropriate* policy question (O'Brien 2000).

Elaborating on the example of assessing risk (to wild salmon) of dredging, why not ask other risk questions (*e.g.*, continuing to allow salmon fishing, agricultural water withdrawal, or predatory bird protection)? The answer is that a choice had been made about how the policy question was to be bounded. Because of this choice, the nature of the risk question is substantially circumscribed and so is the character of the assessment. In the dredging example identified in the last paragraph, it may be that fishing, water withdrawal, dam operations, ocean conditions, release of hatchery-reared salmon, and predation by birds and marine mammals are each a greater risk to the salmon run in question than the proposed dredging, but such information is not reflected in the results of the risk assessment.

Focusing on relatively simplistic ecological risk questions, of course, evades the more germane policy questions that are analytically intractable using risk assessment or any other decision support tool (Karr 1995). Simplistic interpretations of risk may appear to provide the risk assessor a benchmark to determine what society collectively views as ecologically *desired*. Also, risk assessments often extrude an aura of scientific rigor and credibility even if the assumptions upon which the analysis is based limit application or, worse, direct its final outcome to misleading connotations (O'Brien, 2000). The danger of misusing the analytical results under these circumstances is genuine, at least according to critics, because they may be employed to scientifically rationalize incremental degradation of the species and ecosystems. The same criticism or concern is, however, pertinent to all decision support tools.

Complex "Risk" Questions

The difficulty of formulating the appropriate and consensus policy risk question is not unique to salmon policy: a similar situation exists for all complex ecological policy problems (*e.g.*, biological diversity, ecological sustainability, invasive species, genetically altered biota)(Lackey 1997b; Walker *et al*. 2001). Sometimes the difficulty is addressed explicitly and clearly, other times it is hidden behind complex technical analyses (O'Brien 2000).

Technocrats can, of course, define risk questions in ways that can be answered technically, but, unfortunately, few such easily derived risk assessments are relevant

to the principal policy challenges confronting society (O'Brien 2000). Ecology is complex and our understanding of how ecosystems work is limited. Policy making (*e.g.*, risk management) is multifaceted and rarely centers on narrow technocratic issues (Perhac 1996). Therefore there is a strong, pragmatic tendency by analysts to interpret and frame policy issues and, by extension, ecological risk assessment, in ways that can be evaluated scientifically, even though the resulting assessment may be only marginally relevant to the policy issue of interest to decision makers.

Perhaps the most commonly alleged misuse by analysts and scientists in formulating the question in ecological risk assessment is reliance on their personal policy values and priorities rather than on those of the public or elected representatives (Menzie 1995; Lackey 1997a). In philosophical terms this is illustrated classically by shifting the scientific "is" to the political "ought." In science there are no policy "oughts." Animal populations, plant communities, and ecosystems are neither good nor bad, better nor worse, healthy nor sick, unless a *value* criterion is applied. Specifically, *risk* has no definition in ecology unless someone defines what ecological condition or change is adverse from *his* perspective. For example, the introduction of nonindigenous species such as American shad, carp, brook trout, walleye, zebra mussels, dogs, cows, or humans to North America may be either good or bad, depending entirely on the policy or value criteria applied.

Most participants in the debate over ecological risk assessment evade the controversy over *who* decides which ecological condition is *adverse*, but it is an important concern and it underlays apprehensions that risk assessment can be easily manipulated to support or refute any policy position (Menzie 1995). For example, who decides whether it is more important to have thriving populations of exotics such as brook trout, walleye, and smallmouth bass or thriving populations of native species such as chinook salmon, Pacific lamprey, and bull trout?

Ecological risk assessment, and nearly all other decision support tools, are predicated on accepting a fundamental assumption about the characteristics of ecological policy: *anthropocentrism* — the benefits from decisions affecting ecological systems are accruable to humans. Indeed, society may preserve wilderness that few humans actually visit, shield from extinction unsung species that have no known economic or tangible value, and allocate scarce tax dollars to sustain habitats for species without aesthetic appeal, but all such efforts provide benefits to particular groups of people. It is asserted that benefits may be nonmarket, nonmonetary, or merely a way to purchase some indeterminate future insurance, but the decisions will eventually, if indirectly, be evaluated, positively or negatively, from human points of view. Ecosystems, species, or individual organisms may or may not survive based on society's decisions, but benefits are accruable only to man.

From an anthropocentric perspective, risk assessment may provide information to decision-makers in their attempt to weigh ecological alternatives (*e.g.*, comparative risk) on the basis of their relative value to man: protecting a declining salmon run *vs.* providing agricultural products; building highways to facilitate personal mobility *vs.* protecting watersheds to maintain salmon spawning habitat; stocking hatchery salmon *vs.* protecting wild salmon. Contrary to the common supposition, the assumption of anthropocentrism does not necessarily lead to policies that are skewed toward commodity or other tangible benefits.

Another world view is *ecocentrism*. In the extreme form, its basic tenet is that all species are equal; humans are only one species and are no more important than others. Society protects ecosystems because all animals and plants have a *right* to exist. Further, this perspective holds that protecting indigenous biological diversity is important because it is *morally* right, not because biological diversity is or might be important to man.

Not surprisingly, risk assessment is abhorrent to those holding an ecocentric view. For them, the mere discussion of ranking risks to ecosystems or species would be similar to Sophie's choice, deciding who should live and who should not (O'Brien 2000). The policy debate, from an ecocentric perspective, is based on moral standards; thus utilitarian argument plays little or no role. For those individuals who hold an ecocentric world view, or those who lean in that direction, risk assessment has not been well received. In fact, from an ecocentric perspective, risk assessment is little more than a sophisticated tool for condoning ecological triage.

Conclusions

Critics aside, risk assessment continues to be used for analyzing ecological policy options, including complex policy problems such as salmon restoration. In fact, its use is probably increasing. However, despite increasingly familiarity, opposition does not seem to be decreasing.

I do not foresee any near-term technical developments that will lessen much of the controversy over using risk assessment in ecological policy analysis although incremental improvements are likely. Certainly, better techniques to gauge societal values and preferences would be useful, but opinions of risk assessment will continue to range from highly supportive to highly negative, complicated by serious differences over multiple definitions of the same words.

Considering the Pacific Northwest salmon restoration policy issue, focusing

public debate around the first step in risk assessment — framing the risk question being asked — is appropriate. Debates over formulating the "risk" question (*i.e.*, precisely defining the restoration objective in salmon policy) will continue because the debate reflects important, policy-relevant conflicts that analytic tools cannot solve. For example, is the "adverse" event extirpation of a salmon run or simply a decline to a level that does not permit sustainable harvest? *If* the adverse event is defined only in terms of wild fish, what constitutes a "wild" fish? Are only salmon produced by hatchery-bred fish that spawned naturally in natural habitat defined as "wild?" What about hatchery fish that return and spawn naturally? Answers to these questions would define the essence of a risk assessment, but the answers are far from self-evident, nor is there likely to be a societal consensus soon.

To the extent that ecological risk assessment encourages a focus on fundamental salmon policy differences rather than superficial technical or scientific ones, it will be most useful to society. Otherwise, it is merely the latest in a procession of analytical tools, each of which has a role, albeit limited, in ecological policy analysis. As a decision support tool, risk assessment currently can provide useful input into the decision making process, but its contribution is limited by the requirement of up-front, specific, and narrowly defined risk questions.

As for the future of wild salmon in the Pacific Northwest, a societal consensus on an explicit and realistic restoration objective remains elusive, and will likely be so for the foreseeable future. The usually unstated, but *de facto* societal policy objective appears to be one that attempts to slow the rate of decline such that there remain residual runs of wild salmon. Given such a nebulous, yet realistic, public policy objective, risk assessment can still provide helpful, although limited, information to decision makers.

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